Short Answer Type Questions

UNIT–I

Q. 1. ***Write short notes on the Phytochrome.***

Ans. Light is very essential for life. In plants it is of immense importance as it controls germination, growth, development and differentiation, regulates the photosynthesis, pigment formation and affects many metabolic activities. Light sensitive seeds of lettuce (*Lactuca sativa*) show even no germination in complete darkness and 100% germination in a flash of red light. And when the far red light was given, the effect was reversed with ? the inhibition of germination. The similar was the case found with the flowring of *Xanthium* and many more other plants revealed results obtained in such photoresponse experiments in various plants revealed the existence of light sensitive pigment that control growth and flowering of plants. This leads to the isolation of the photoreceptor pigment **"Phytochrome"** as named by Butler et al.

Phytochrome is widely distributed in plant kingdom. It is bluish protein present in cytoplasm of cells. Phytochrome has two forms which are interconvertible, phytochrome red absorbed form (Pr) which is stable near dark, absorbs strongly near 660 nm and weakly in blue and ultraviolet regin and is instantly changed into far red form (Pfr) which absorbs near 730 nm and is converted back to Pr.

Similarities in the phytochrome action spectra and absorption spectra of algal chromprotein, i.e. C-phycocyanin and allphycocyanin provided an early clue to the nature of phytochrome. Now the resemblance of former with the latter is quite evident. Phytochrome is wide accepter to have non-cyclized tetrapyrrole structure where four pyrrole units are joined linearly. The conjugated double bonds increase during Pr to Pfr conversion.

The photoresponses are of three types—the positive, negative and complex. These all are the direct action of Pfr. Phytochrome triggers the reaction and the response depends upon the prior history, specificity and in short, the genetic control.

Q. 2. ***Write short notes on the Micropropagation.***

Ans. Clonal propagation essentially involves production of generally identical and uniform plants with predictable selected qualities. A clone is a

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genetically alike progeny of a single plant derived from its vegetative cells or organs. To avoid any genetic variations the normal practice has been to utilise rhizomes, runners, bulbils, stem cuttings, etc., to propagate desired plants retaining their original characters as opposed to the propagation through seeds which brings in a lot of variation owing to gameti union. However, these techniques are applicable to only a few plants and the rate of multiplication and propagation is low and time consuming. Tissue culture techniques are the alternative means from the conventional ones of clonal propagation and multiplication. The advantages of tissue culture techniques over conventional ones are that in a relatively short time and space a large number of plants can be produced starting from a single individual.

Rapid advances have been made in recent years in plant tissue culture. All out efforts towards crop improvement, clonal propagation and multiplication are highly supported by the application of these techniques by horticulturists, plant breeders and foresters. In India also pioneering work was carried out on the production of haploids, and clonal propagation of forest trees, plantation crops, vegetable and fruit trees, medicinal plants and ornamentals and other economically important plants.

Clonal propagation (micropropagation) as it involves only a small amount of tissue can be achieved by the following methods (i) Meristem culture, (ii) Organogenesis, (iii) Somatic embryogenesis.

(a) Meristem culture. For micropropagation normal techniques of tissue culture are applied. The various steps followed are as follows :

(i) Nutritional requirements. For maintaining cultures proper nutrients are supplied to the growing explant. These includes macro-and micro mineral elements, organic ingredients (amino acids, vitamin B complex, etc.), Sucrose- (as carbon source), Inositol and Hormones (auxins and cytokinins, etc.) The nutrient medium is jelled by agar.

(ii) Culture vessels. Plant material is inoculated in glass vessels containing the nutrient media. Depending upon the convenience one can use culture tubes. Erlenmeyer flasks or petriplates. Now a days polythene vessles and wide mouth screw bottles are also used. The vessels are plugged with non-absorbant cotton.

(iii) The cultures are maintained under strict sterilized conditions. Therefore, it is necessary that glassware, nutrient medium, explants and the

place of inoculation should be properly sterilized. Glassware is sterilized by dry hot air at 160-180°C for 48 hrs. Media are autoclaved at 1.06 kg/cm^3, explants are surface sterilized by any of the sterilizing agent like calcium hypochlorite [5.10%], sodium hypochlorite [2-7%], hydrogen peroxide [2-6%], mercuric chloride [0.01%], etc. The inoculation is done under sterilized chamber or laminar air flow bench.

Q. 3. ***Write short notes on the Protoplast isolation.***

Ans. Since the first isolation of plant protoplasts demonstrated by E.C. Cocking in 1960, much development has taken place in the field of protoplast isolation, culture and fusion. The isolated protoplast behaves like unicellular organism and the naked cells can be made to regenerate into a complete plant after making all types of manipulations and osmotic fusion. The techniques of genetic engineering are now easily applied by DNA modification. Another important property of naked cell is that it can easily uptake the macromolecules such as DNA, cell organelles, plasmids, viruses, bacteria, etc. Thus totipotent nature and the property of uptake of foreign bodies the fusion of membrane have opened up an entirely new areas of fundamental and applied research in experimental biology and somatic cell genetics.

Isolation of protoplast. There are two main techniques of isolation of protoplast :

1. Direct Method. The leaf peel segments are subjected to enzyme mixture in one step (0.5% macrozyme + % Onozuka in 13% sorbitol or mannitol at pH, 5.4 incubated for 15-18 hr). They are filtered and washed after centrifugation at 100 g for 1 min. This process is repeated 2-3 times and then floated ino.

2. Sequential Method. In the first step segments are treated with macrozyme 0.5%, K-dextran sulphate 0.3% in 13% mannitol at pH 6.8 and in the second step the enzyme mixture contains 2% cellulase in a 13% solution of mannitol at pH 5.4 for 90 min at 30°C. The isolated protoplasts are washed and maintained in sucrose solution. It is important that proper should be used to mtainin the isolated protoplast.

Q. 4. ***Write short notes on the Somaclonal variation.***

Ans. Many of the genetic variations are manifested as heritable mutation among the progeny of regenerated plants. This phenomenon is called

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somaclonal variations. Identifying a variant as a somaclonal mutant requires genetic testing of regenerants by selfing and appropriate crossing for sexually propagated species. While in asexually reproduced species clonal propagation is the bases. Somaclonal variations have been reprorted in a number of important crop plants, like wheat, maize, sugarcane, tomato, potato, etc. There are many factors responsible for influencing somaclon variations like :

(i) Sexual versus asexual species,

(ii) Pre-existing versus culture induced variations,

(iii) Genotype,

(iv) Explant type and culture methods,

(v) Duration of culture, etc.

The cause of genetic instability and somaclonal variations is :

(i) Chromosomal aberrations,

(ii) DNA amplification,

(iii) Transposable elements, etc.

The impact of somaclonal variation is seen primarily in the plant breeding programmes. One of the major potential benefits of somaclonal variation is the creation of additional genetic variability in coadopted, agronomically useful cultivars, without the need of resort to hybridization.

Q. 5. ***Write short notes on the Androgenesis.***

Ans. Development of haploids from the pollen culture is known as **androgenesis**. For he induction of androgenesis the stage of pollen development at which the anthers are cultured may be more critical than the composition of the nutrient medium. In *Arabiodopsis thaliana* and *Lycopersicon esulentum* the ideal condition for androgenesis is when the microspore mother cells are in meiosis. Besides, the age of the donor plant and the environmental conditions under which it is grown also influence the androgenic response in another culture. Generally, another from young plants are more responsive. Occasionally, pretreatment of anothers at high temperatures may permit improving the rate of androgenesis. Strikin

Q. 6. ***Write short notes on the Microsurgical techniques.***

Ans. Microsurgical techniques are generally used for embryo-nurse endosperm transplant. Such experiments are aimed to study two morphogenic problems :

(i) regeneration potentialities of various parts of the embryo, and

(ii) interaction between different parts of the embryo during germination.

Q.7. ***Explain about Free-cell Suspension Culture.***

Ans. Cell suspension culture is the most convenient mode of mass cultivation of cells and large-scale production of secondary compounds. Suspens- ion cultures of plant cells should have adequate growth rates for efficient product formation which can be possible only by providing necessary culture requirements.

(A) Application of Bioreactors— In a normal culture vial, a cell suspension grows to relatively low densities because of the minimal quantity of nutrients available in the medium within the limited space of the vessel. Therefore, a wide variety of culture vessels ranging in size from 21 to 20,000 1 have been designed to grow high densities of plant cells *(see* review by Fowler 1982). Two main problems encountered during the cultivation of cells at high density are the supply of oxygen and hydrodynamic stresses generated by the aeration-agitation system with-in the culture vessel. Taking into account these parameters of mass scale cell culture some basic types of airlift bioreactors have been designed. These airlift systems can support biomass levels of 30 gl^{-1} dry weight without the development of stagnant zones since one of the important considerations with these systems is that the mixing capacity is linked with a proportionate outlet of gases. Otherwise the accumulation of gases at high levels could be inhibitory to growth and metabolic formation. Tanaka reported that establishment of high-density cultures for large-scale production; of shikonin derivatives was possible by using the bioreactor with a modified paddle type impeller or a rotating drum. Both these types of bioreactors are used to successfully cultivate shikonin cells upto 75 gl^{-1} dry weight. A high yield of berberine (3 gl^{-1}) has been achieved in a reactor with a hollow paddle-type stirrer.

Stirred-tank reactors with modified impellers that import improved mixing under low shear have been advocated for large-scale cultivation of fragile plant cell suspension cultures. Hooker et al. (1990) studied the effect of power consum-ption, flow pattern, the type of impeller, its size and position relative to air-liquid interface and agitation speed on cell growth in batch cultures. A large flat-bladed turbine impeller (7.6 cm dia. 14.0 cm width) has been found to be optimal for phenolic production from tobacco cell cultures in a 5-litre reactor. Such impellers with high width-to-diameter ratio impart more gradual velocity gradients than the regular flat-bladed disc turbine thus providing well-distributed mixing patterns without dead zones at low shear. However, the use of different agitation speeds during different stages of growth would

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be a more rational approach to successful cultivation a plant cells while using bioreactors.

Oxygen plays a major role in the energetics of plant cells in cultures. Some cultures require CO2 in addition to O2 to improve cell growth and metabolite synthesis. It is important that the level of these gases be controlled for their optimal utilisation in a bioreactor. Smith et al. (1990)

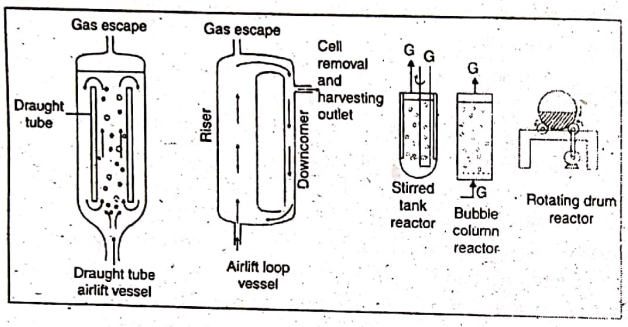

Fig. 7.1. Configuration of different types of bioreactors used for lage-scale plant cell culture.

described a bioreactor control system for controlling the dissolved concentrations of both oxygen and carbon dioxide simultaneously. Using a mathematical model, a strategy was developed that allowed the concentrations to be controlled without changing either the total gas-flow rate of the agitation speed; thereby imparting constant shear conditions in the reactor. This strategy has been shown to be applicable for both short and long-term cultivation of *Catharanthus roseus* cells.

(B) Mode of culture—To maximise product formation various modes of cell culture have been followed. The fed-batch mode is used in cases in which the addition of a high concentration of substrate or sucrose affects the growth of the suspension culture. Fermenter culture design for *Morinda citrifolia* cell lines directing anthraquinone accu-mulation is shown in Fig. A semi-continuous or draw-fill mode of repeated batch cultures provides a suitable approach towards continuous cultivation of plant cells when the rate of product synthesis parallels the rate of growth. Two-stage cutlure is the obvious choice when cells are first propagated in a growth medium and then transferred to a production wedium and then transferred to a production medium for synthesis of secondary compounds.

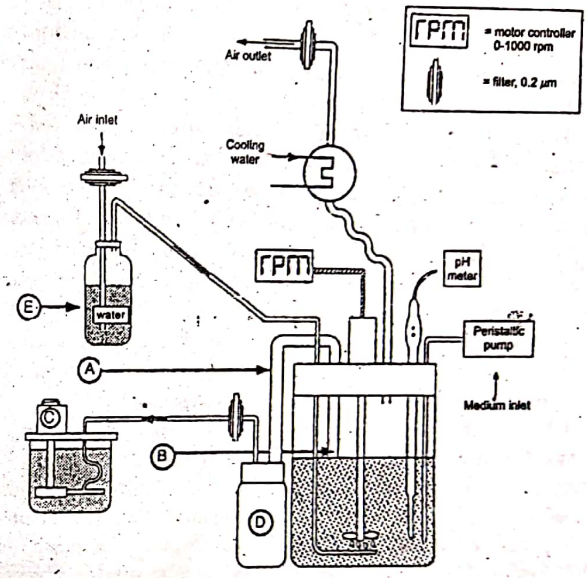

Fig 7.2. Schematic drawing of the fermenter cultures. Fresh medium is pumped into the culture vessel at a constant rate. The overflow/sample is removed by a vacuum pump (C) through an enlarged tube (A) that is placed at a certain height to keep the culture volume constant (B). The overflow is collected in a sample bottle (D). The incoming air is moistened by leading it through a bottle filled with sterile water (E).

Q. 8. ***Explain about Immobilised Plant cell cultrue.***

Ans. The development of a new technique, known as surface immobilised plant cell (SIPC), is the most significant contribution in recent years. SIPC efficiently retains the inoculum and growing biomass even at higher mixing rates. Cells are protected from high-liquid shear stresses and there is better cell-to-cell contact. The product formation is optimised by decoupling this phase from the growth phase (Rosevear 1988).

Methods of immobilisation are widely based on gel or membrane entrapment. Alg-inate gel-trapped immobilised systems effectively enhance the production of secondary metabolites in a number of species. Employment of *elicitors* in these systems to stimulate secondary metabolism and application

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of a resin for adsorption of the product have further helped in releasing a higher quantity of secondary products. A further significance of these chemical 'helpers' is that the potential for enhancing the secondary compound production (normally stored intracellularly in vacuoles) can be achieved without using perme-ability agents, or inducing cyclic changes in pH, that might have deleterious effects on cells

(A) Entrapment in Gels—Procedures currently employed for the immobili-sation of cultured plant cells are similar to those used for micro-organisms. Entrapment of cells or protoplasts is carried out in some kind of gel (alginate, carrageenin, agar, agarose and so forth) or combination of gels which are allowed to ploymerise around them. The first report using this approach was described by Brodelius et al. who immobilised *Catharanthus roseus, Digitalis lanata* and *Modnda citrifolia* cells by their entrapment in a matrix of calcium Alginate. Since then a number of reports have appeared on the application of gels for plant cell immobilisation. The protocol for entrapment of plant cells in various kinds of gels is given in Appendix 17.1.

Q. 9. *Explain about Entrapment in Nets or Foam.*

Ans. Lindsey et al. demonstrated that cells of various species growing actively in a liquid nutrient medium can be readily immobilised in blocks of polyurethane foam in a one-step process. The foam (reticulate polyurethane of various pore sizes, or polyester Declon; Corby, Northants, England) may be used in blocks of 1 cm3 However, it is likely that in fixed-bed bioreactors sheets will be most effective (Yeoman 1987). Blocks of the gel are immersed in the cell suspension and flasks agitated on a rotary shaker. Initially the free cells and cell aggregates are washed in and out of the blocks but soon the aggregates become trapped deep within the inert matrix. The component cells divide within the compartments of the foam and form large aggregates. After two weeks, or when the entire block has filled with cells, the loaded cubes are transferred to a low-growth medium which supports metabolic activity but not active cell division. Generally, the absence or presence of amedium do not proliterate futher and cell remain contained to the from without being released into the mediam.

UNIT–II

Q. 10. *Explain briefly about Biodiversity.*

Ans. Ever since the dawn of human civilisation, biodiversity has been the backbone of human food, health and livelihood providing systems. The importance of biodiversity is economic, environmental, scientific and medical. The Global Convention on biodiversity (CBD) was adopted at the UN

nference on Environment and Development in 1992. The CBD officially me into force in December 1993 and by January 2000, over 170 nations d ratified the CBD, which is a unique international agreement for nservation and sustainable use of biodiversity.

The term "biodiversity" is a concise form of "Biological Diversity" and s coined by Walter G. Rosen in 1986. The definition of biodiversity, as ovided in Article 2 of Convention on Biodiversity (CBD), is as follows iological diversity means the variability among living organisms from all urces including, inter alia, terrestrial, marine and other ecosystems and the ological complexes of which they are part; this includes diversity within ecies, between species and of ecosystems."

Biodiversity is not just the numbers of organisms present in any natural osystem. Biodiversity as such is not a resource but a property of living stem. CBD is one of the main global attempts to set an agenda for maintaining odiversity. According to Harvey B Lillywhite (2002), the term referes to he variety and variability among living organisms and the ecological mplexes in which they occur".

These days we find lot of focus and public concern for biodiversity. As ample, the Academic Press has recently announced the poublicaiton of a ve-volume `*Encyolopedia of Biodiversity*' containing more than 300 separate ticles and covering 20 different subject areas related to this tropic. Numerous pects of research in the field of "conservation biology" are related to issues biodiversity and biological researches at communiy or ecosystem level are odiversity dependent.

The subject also is important to many developments in biotechnology, r example the genetic engineering for control of exotic species. To illustrate e level of concen for biodiversity issues that has emerged interntationally, e Organisation for Economic Cooperation recently approved Facility (GBIF) ll contain not only a catalogue of all the known species, but will also include ores of databases related to molecular and genetic collections, geospatial formations and natural history daya. During recent years our predominant roaches to understanding biodiversity related issues have come from the s of ecology, population biology and genetics. However, we have ignored ysiological approach to understand issues and paradigms related to diversity.

Q. 11. *Explain briefly about Producer.*

Ans. The interrelations between organisms and environment on the land stitute *terrestrial ecology*. It is characterized by comparatively dry

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environment as compared to aquatic ecology. Characteristic features of land environment are :

(1) Lack of moisture and predominance of dehydration.
(2) Occurrence of more temperature variations.
(3) Presence of almost constant content of O_2 and CO_2.
(4) Evolution of strong skeletons.
(5) Presence of geographical barriers.
(6) Extreme complex nature of the substrate (soil) being as a source of variable nutrients.

The terrestrial ecology may be studies uner the following heads :

(1) Terrestrial biota and biogeographic regions.
(2) Terrestrial communities.
(3) Distribution of terrestrial communities : Biomes.
(4) Division of terrestrial ecosystem.

Terrestrial Biota and Regions

Most complex and specialized forms have developed on the land as a result of evolution, such as angiosperms, insects and warm-blooded vertebrates. Human population, growing year by year, exerts a greater contorl in the operation of terrestrial ecosystem. Thus each land area tends to posses its own fauna and flora and likewise islands differ greatly from mainland. Wallace and Darwin, the pioneers of Natural Selection Theory, first of all set up system of biogeographical regions, each having characteristics flora and fauna. In its, organisms occuyping same ecological niches in similar communitires belonging to different regions are termed as *ecological equivalents*. These may be closely related forms taxonomically, *e.g.*, kangaroos of Australia being qnivalent to antelope and bison of North America.

Land animals and plants are extremely variable forming large groups of communities. Generally, these have been classified into three categories. *i.e.*, producers, consumers and decomposers.

Producers (Autotrophs)

These form the main part of the terrestrial community and comprise large-rooted green plants acting as main food makes. These may be further *herbaceous, shrubs* or *tree* depending on the size of their body. According to environmental adaptations, these producers may be *zerophyte* (day), *hydrophyte* (wet), *mesophyte* (moist) or *halophyte* (saltish). Recently, Raunkaiier (1934) proposal another classification of life forms, based on opposition of the renewal buds as follows :

1. Epiphytes. Aerial plants having no roots in soil.

2. Phanerophytes. These are also aerial plants having renewal buds exposed on the stem, *e.g.*, herbs, shrubs and trees.

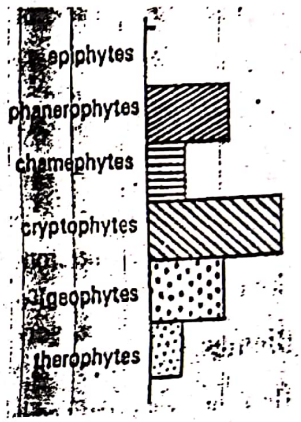

Fig. 11.1. Ratios of six different life forms of land plants.

3. Chaeophytes. Surface crawling plants with buds over soil surface.

4. Geophytes. Land plants having buds in the soil on a bulb or rhizome.

5. Therophytes. These are plants having their complete life cycle from seed in one vegetative period.

Q. 12. *Explain briefly about Species Diversity in Coomunities.*

Ans. Diversity refers to a state of variety or difference among members of a collection. The species diversity is usually measured by the number of species in a community and their relative abundances. It consists of two components :

(1) *Richness* refers to number of species present and
(2) *Evenness* or equitability which is relative abundance of species.

In ecosystems, diversity can be recognized at three levels, namely, *alpha diversity* within a specific community or habitat, *beta diversity* across several communities or an environmental gradient and *gamma diversity* across a range of habitats in a geographic area as described by Whittaker.

Dayton described communities of intertidal marine ecosystem. According to him dominant fugititve and understory species constitute these communities. The *dominant species* also called foundation species are tall canopy-forming algae which outcompete other species for light by overtopping them. *Fugitive species* invade when dominants are removed.

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They quickly colonize new spacies. Another *understory species* die after the dominants are removed and become recolonized as dominants become reestablished.

Communities exhibit various degrees of dominance in the species. As described earlier, it is the dominants which account for the energy-flow in each trophic group, but in community as a whole. it is the large numbers of rare organisms (species) which determine species diversity of the trophic groups. The major comonents of species diversity comprise species richness or variety component and evenness or equitability.

Besides, these species effects on the community may be modified by some other groups of species within the major community. Such minor aggregations of plants and animals are called *societies* which may be either *layer societies* occupying different strata or *local socïeties* which may be confined more especialy to area (ant hill). There occurs also *seasonal varieties* which include the organisms at a particular time of the year. The *biomass* of any species refers to the average weight or volume of average individual being multiplied by the total number of individuals present. The number of biomass or individuals present in community at one time constitute *standing crop*. The prhe production of the organic matter/unit of area and time is called *productivity*.

Community Periodicity

A distinct community is a dynamic entity, constantly changing both seasonally and with diel cycle (24 hrs.). Usually this periodicty or periodical changes in the community may occur in four seasons, namely winter, spring, summer and autumn based on weather conditions. In temperate zones, ecologists divide communiti periodicity into the following categories.

1. Prevernal period. It is the early spring period beginning in March and terminating in mid-April. During it, harder vegatation begins to grow, hibernating animals begin to emerge and some birds start migrating northwards on theirr way to summer nesting sites.

2. Vernal period. It includes late spring and lasts for one and half month (late April and May). During this period, as the temperature rises, tree leafs, hatching of insects takes place and several plant show early fruits.

3. Summer period. It consists of early summer (June to early July) so called *estival period* and late summer (from July to September) designated as *serotinal period*. During these periods, there occur maximum growth of plants and animals as he conditions are optimal. There may be *aestivation* os some biota which causes physiological depression.

4. Autumnal period. It ranges from late September to early November and is characterized by lower temperature, gradual defolisation of deciduous vegetations, annual southward migration of avifauna and movement of many animals to protected habitats. In the late autumn, many vertebrate collect fod and get ready to prepare *hibernicula* (hibernating areas).

5. Hiemal period. It is also called winter period beginning in November and lasts until mid-March. Durin this period, most organisms which are intolerant to lower temperatures get encysted or hibernated. Tolerate species are also less active. In nature, there exists no sharp demarcation between the seasonal periods and those of communities since it also depends on latitude and altitude of the region.

Q. 13. *Explain briefly about Diversity-Stability Relationship.*

Ans. A.R. Wallace had suggested that diversity in the trophic was greater than in temperate regions, because tropical regions have enjoyed longer periods of *stability* and, thus, have had more time for species differentiation. This idea is now sometimes referred to as the *time hypothesis* of species diversity. A number of evidences are available to support the time hypothesis. Evidence from the fossil record that diversity has increased over time, also supports the time hypothesis.

Four hypothesis have been proposed to explain how much biodiversity is enough and how ecosystem processes may respond to reduction in biodiversity. The *diversity-stability hypothesis* proposes that ecological commuities will decrease in ability to recover fro disturbance and in productivity if there is reduction in species richness. According to *rivet hypothesis*, the relationship between species richness and ecosystem functioning is non-linear, but may follow a variety of possible trajectories. The loss of a few species (or rivets holding together an aeroplane) will create no problem but beyond a certain point losses will cause catastrophic effect. The *redundant species hypothesis* predicts that a minimal diversity is necessary for ecosystem processes, but beyond this most species are redundant in their roles. And finally, the *idiosyncratic response hypothesis* proposes that with changes in biodiversity ecosystem processes also change, but the magnitude and direction of change is not predictable because each individual species has complex and varied roles.

However, it is difficult to answer the questions - how much biodiversity is needed ? But diversity-stability hypothesis is supported by many studies (spring-fed hillstreams in the Garhwal region support more biological diversity

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of aquatic insects than large snow-fed rivers which are more disturbed) and we may like to have some functionally redundant (?) species because they are beautiful', if not `useful'.

Biodiversity Crisis

The present and projected losses of biodiversity have been termed a `crisis'. The crisis is particularly more serious in developing countries like India. Serious losses of biodiversity are presently taking place all over the world. It follows that the `bottom line' is how much of biodiversity can we alter, or loose, before we threaten our own existence (Gaston and Spicer, 1998). The erosion of biodiversity may be attributed to the following factors.

Q. 14. ***Explain briefly about Medicinal Plants.***

Ans. Since time immemorial plants have used for the treatment of various ailments. Even today several important drugs used in the modern system of medicine are obtained from plants. The use of medicinal plants has figured in several ancient manuscripts like the Rigveda, the Bible, the Iliad, the Odyssey, and the History of Herodotus. As far back as 4000 B.C. the ancient Chinese were using drug plants. The earliest reference to the use of medicinal plants as a cure for diseases is found in the manuscript of 'Eber Papyrus', writtein in 1600 B.C. The Greeks and Romans were also familiar with many of the present day drugs as is evident from the work of Hippocrates (460–370 B.C.), Aristotle (384–322 B.C.), Theophrastus (370–287 B.C.), Pliny the Elder (23–79 A.D.), Dioscorides (50–100 A.D.) and Galan (131–201 A.D.). Hippocrates, known as the father of medicine, was the first person who tried to explain the diseases on a scientific basis. Dioscorides *De Materia Medica* was an invaluable and authoritative book on medicinal palnts. In the 16th century, several herbals were published; the important being those of Brunfels (1530), Bock (1539), Fuchs (1542), Cordus (1561) and L'Obel (1576). At about the same time Paracelsus (1493–1541) advanced *Doctrine of signatures*, which advocated that all plants useful for man possessed certain forms and shapes that indicated their specific use in the treatment of similarly shaped organs in the human body. For instance, plants with heart-shaped leaves were used for cardiac disorders, walnut as brain tonic and pomegranate seeds for dental diseases. With the advancement of our knowledge, such superstitions were gradually lost.

In India, earliest references to medicinal plants appear in the *Rigveda*, written between 3500 and 1600 B.C. In *Atharvaveda* too, detailed descriptions

of several medicinal plants were given. In *Ayurveda*, definite properties of drugs obtained from plants and their uses have been given in some details. *Charaka-Samhita* and *Susruta-Samhita* are two important works dealing with some 700 medicinal plants of India.

Most of the drug plants are wild and only a few of them have been cultivated. Studies of medicinal plants based on ancient literature and its investigation in the modern light is known as ethnology. The branch of medicine dealing with the history, botany, identification, preservation and commerce of crude drugs is known as Pharmacognosy. Pharmacology is the study of the action of drugs on an organ or organism.

The medicinal importance of a plant is due to the presence of some special substances like alkaloids, glycosides, resins, volatile oils, gums, tannins, etc. These active principles usually remain concentrated in the storage organs of the plant, viz, roots, seeds, back, leaves, etc.

UNIT–III

Q. 15. ***Explain briefly about Biosphere Reserves.***

Ans. Biosphere Reserve Programme was launched he **UNESCO** in 1971 under its "Man and the Biosphere" programme (MAB). The purpose of the formation of biosphere reserve was to conserve in situ all forms of life, along with its support systems in its totality. The following are the objectives the Biosphere Reserve Programme (BRP) :

(a) Conserve representative samples of ecosystem.
(b) Provide long-term in-situ conservation of general diversity.
(c) Promote and facilitate basic and applied research and monitorning.
(d) Provide opportunities for education and training.
(e) Promote appropriate sustainable management of the living resource.
(f) Disseminate the experience so as to promote sustainable development elsewhere, and
(g) Promote World Conservation Strategy. The first Biosphere Reserve Congress was held at Mind (Belarus) in 1983 and reported 226 biosphere reserves in 62 countries around the world 1985, there were 243 biosphere reserves 65 countries in the world. In covering an area over 115 million hectares. Only 90 out of geographical provinces (belonging to each realms) had biosphere reserves, the remain 103 were still to be represented in BRP. Second Congress was held at Seville and reported 324 biosphere reserves in countries. Presently there are 425 biosphere reserves in 95 countries.

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Biosphere reserves include natural, minimally disturbed, man-modified and degraded ecosystems. For management purposes, the biosphere reserve areas are divided into : (i) core zone. It represents natural and minimally disturbed ecosystems. (ii) manipulation (foresty) zone. It includes the man-made forests and selected felling areas. (iii) manipulation (tourism) zone.

Q. 16. ***Explain briefly about Hot sport of Indian Biodiversity.***

Ans. Biodiversity hot spots were originally identified by Norman Myers in 1990s. A hot spot (also written as hotspot) is an area which faces serious threat from human activities and supports a unique biodiversity with representatives of evolutionary processes of speciation and extinction. It is also defined as a geographical zone or ecological niche with a large number of endemic plants. There are 20 hot spots of biodiversity all over the world, a habitat of about 49,550 endemic species of higher plants representing about 20% of the world's total plant species. Out of 20 hot spots of the world, 12 are tropical rain forest regions (hawaii, Colombian Choco, West Ecuador, Uplands of West Amazonia, Atlantic forest area of Brazil, Eastern Madagascar, Peninsular Malaysia, East Himalayas, North Borneo, Philippines, Queensland Australia and new Caledonia) whereas the remaining eight (California Floristic province, Central Chile, Ivory coast, Cape Floristic Province, East Arc forests of Tanzania, Western Ghats, Sri Lanka and Southwest Australia) are in other climatic ecosystems. The number of hot spots in the world has now increased to 34 (just 1.4 per cent 4 the world land but supporting 60 per cent of species of plants on the earth).

India has four hot spots. These are North-East, Eastern Himalayas, Western Ghats and Andaman and Nicobar Islands. The rate of deforestation in the areas is very high and ecosystems have reached a fragile stage. The highest concentration of species is found in these areas. In addition to these, species hot spots are the mangroves, wetlands and swarm.

The floristic richness has rendered the Non East region and Western ghats to be recognised two hot spots among 20 hot spots identity throughout the world. In addition to these two, there are about 40 other sites in different biogeography zones of India which have high degree of endemism and genetic diversity. These are as follows :

1. Andaman group of islands
2. Nicobar group of islands
3. Agasthyamalai Hills

4. Anamalai and High Ranges (Cardamom Hitch)
5. Palni and Highway Mountains
6. Nilgiris, Silent Valley - Wyanaad - Kot
7. Shimoga - Kanara
8. Mahabaleshwar - Khandala Ranges
9. Kohkan - Raigad
10. Marathwada - Satpura Ranges
11. Tirupati - Cuddappa - Nallamalai Hills
12. Vizagapatnam – Ganjam – Jeypore
13. Southern Deccan (Leeward side)
14. Chotanagar Plateau
15. Khatiawar - Kutch
16. Rajasthan – Aravalli
17. Khasia – Jaintia Hills
18. Patoki - Manipur - Lushai Hills
19. Assam
20. Arunachal Pradesh Himalaya
21. Sikkim Himalaya
22. Garhwal - Kumaon Himalaya
23. Lahul - Himachal Pradesh Himalayad
24. Kashmir - Ladakh Himalaya
25. Nepal (interface of E. Himalaya W. Himalaya)
26. Eastern Himalaya
27. Khasi - Jaintia - Lushai
28. Central India
29. Eastern Ghats
30. Southern Eastern Western Ghats
31. Northern Western Ghats
32. Western Himalayas
33. Sandstone Flora of Dun and Mussorie
34. Myristica Swamps of Kerala
35. Sea grasses of Coromandel Coast.

Q. 17. ***Explain briefly about IUCN Red Data Books.***

Ans. To highlight the legal status of rare species for the purpose of conservation, the International Union for Conservation of Nature and Natural Resources (IUCN) has established the five main conservation categories. These

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are extinct, endangered, vulnerable, rare and insufficiently known species. IUCN, also known as the World Conservation Union, with Headquarters at Gland, Switzerland, is the premier coordinating body for international conservation efforts. It produces directories of specialists who are knowledgable about captive breeding programmes and other aspects of conservation. Using the IUCN categories, the World Conservation Monitoring Centre (WCMC) has evaluated and described threats to about 60,000 plant and 200 animal species in its series of Red Data Books. Threatened species include those which are endangered, vulnerable, and rare in IUCN categories. The great majority of the species on these lists of Red Data Books are plants. However, there are also species of fish (343), amphibians (50), reptiles (170), invertebrates (1355), birds (1037) and mammals (497). The IUCN system has been applied to specific geographical areas as a way to highlight conservation priorities. Malaysia is such an example.

To help focus attention on the threatened species most in need of immediate conservation efforts, IUCN has begun to issue lists of the world's most threatened plants and animals. These lists include species of unique conservation value. A rare flightless bird, Kago in New Caledonia, a primitive wild OX from Southest Asia and the Orinoco River Crocidile have gone near extinction. The plant list includes the giant *Rafflesia* of Sumatran rain forest, and the African violet, now occurring wild only in central Tanzania. On a global basis, the IUCN have estimated that about 10% of the World's Vascular plant species totalling to about 20,000–25,000 species are under varying degrees of threat. Simultaneously, to include information on threatened biological species, the IUCN had started publication of Red Data Books on animals and plants. IUCN (1988) published the IUCN Red List of Threatened Animals. Earlier in 1978 IUCN had already published similar account on plants in the book, IUCN Plant Red Data Book (Eds. Lucas and Synge, 1978).

Due to pressure on account of environmental changes, 11,046 species of plants and animals are facing high risk of extinction (IUCN, 2000). While plant species are declining rapidly in South America, Central and West Africa, and South-East Asia, mammals and birds are disappearing faster in Brazil, India, and China. In India, all the eight species of vultures are declining fast.

Q. 18. ***Explain briefly about Biodiversity of India.***

Ans. India is one of the twelve mega-biodiversity countries of the world. Each of the ten biogeographic zones of the country has characteristic biota,

and broadly represents similar climatic conditions and constitutes the habitat for diverse species of flora and fauna. An account of the dominant species of flora and fauna of the country has already been presented in this question. Based on a survey of about two-third of the geographical area of the country, the Ministry of Forest and Environment reported that India have at present about 45,000 plants and 77,000 of animals species representing about 7% of the world flora and 6.5% of the world fauna respectively (GOI, 2000), representing about 6.5% of the global biodiversity.

A significant feature of the Indian flora is the confluence of floras from the surrounding countries like Malaya, China, Tibet, Japan and Europe and even from distant countries like America, Africa and Australia.

The different species of plants (including bacteria and fungi) are as follows :

Bacteria	850
fungi	23,000
Algae	2,500
Bryophytes	2,564
Pteridophytes	10,22
Gymnosperms	64
Angiosperms	15,000/17,500
Total	45,000/47,500

The different species of animals are as follows :

Insects	57,525
Lower groups	9,214
Molluses	5,042
Fish	2,546
Birds	1228
Echinoderms	765
Reptiles	428
Amphibia	204
Mammals	372
Protochordates	116
Hemichordates	12
Total	77,452

Q. 19. ***Explain briefly about National Parks and Sanctuaries.***

Ans. There were 19 National Parks (NP) and 202 Sanctuaries (Sants) in India in 1981 extending over. 74,763 sq. km., about 2.3% of the total

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geographical area. By 1983, the number increased to 44 NP and 207 Sants covering 88,000 sq. km. thus protected areas constituting 27% of the country area. The 207 Sants, extended over an area of 69,698 sq. km. and 44 NP covered 18,037 sq. km. There have been further additions and till June 1989 there were 67 National Parks and 394 Sanctuaries with a total area of about 1,41,298 sq. km. representing roughly 4% of the country's geographic area. State-wise break-up of UP and Sanctuaries till June 1988 is shown in Table 14.7. There have been further additions and till June 1992 there were 73 National Parks and 416 Sanctuaries. By the year 2000 there were 88 NP and 490 sanctuaries in India covering an area of 1.53 lakh km^2.

National Parks in India

It is exciting to be in India and it is far more exciting to be in the confines of an Indian National Park. Away from the confines of concrete jungles that covers most part of the big cities. greenery and fresh air provided by Indian wildlife parks as far cry from the usual. Wildlife heritage of India is as much or more magadiverse than the cultural heritage this country posses. One of the major mega diversity countries in the world, India houses a good number of wildlife species found nowhere else on this globe. India is a natural place for the wildlife enthusiasts of the world. The reasons are simple but exciting. India currently has 88 national parks.

These national parks in turn houses largest number of tigers found in the world, largest number of one-horned rhinos found in the world, now almost extinct Asiatic lions, and a large percent of elephants. These wildlife animals are but only a part of more than 500 species of mammals who have made India their natural home. Apart from the mammals, India is also blessed with over 2000 species of birds, over 500 species of reptiles and amphibians and around 30000 species of insects including colorful butterflies.

UNIT–IV

Q. 20. ***Explain briefly about in-situ consevation.***

Ans. This is the conservation of genetic resources through their maintenance within natural or even human-made ecosystems in which they occur. Natural habitats are declared as protected areas. This system of protected areas includes different categories such as

(a) Biosphere Reserves
(b) National Parks
(c) Wildlife Sanctuaries
(d) World Heritage Sites/Sacred Groves/National Monuments/Cultural Landscapes

Q. 21. ***Explain briefly about ex-situ conservation.***

Ans. This is the conservation outside their habitats, which includes

(a) Botanical Gardens/Arboreta/Herbal Gardens
(b) Seed (Germplasm) Banks
(c) Pollen Banks/Semen Bank/Ovum Bank
(d) Biotechnology Use (Tissue culture, genetic engineering etc.)

Reptiles : Several turtle, tortoise and terrapin as leatherback or trunk turtle, the green sea turtle, the loggerhead and the hawksbill or tortoise shell turtle, the estuarine crocodile, the marsh crocodile and the gharial; monitor lizards; Indian phython, Indian egg-eating snake.

Amphibia : The viviparous toad, Indian salamander.

Invertebrates : ***Crustacea*** **:** The coconut or robber crab, (a large hermit crab).

Insecta **:** Some dragonflies, butterflies and moths and beetles, most endangered ones is tillyards dragonfly; of moths and butterflies, 55 forms are known in India, of which 14 are rare.

UNIT–V

Q. 22. ***Explain briefly about Student 't' Test.***

Ans. In biological experiments it becomes essential to compare the means of two samples to draw a conclusion. Often we come across many instances of comparison in between mean value of T_4 injection and rate of respiration of two groups of species of animal, effect of pesticide and control of insect. Such examples in biological studies need some statistical treatment before interpreting the results. In other words visual expression of the difference between the two sample means usually fail to give significant difference. Therefore, the degree of level of significance of difference between two means is to be qualified to reach a definite conclusion.

To test the significance of difference of means of two samples, **W.S. Gosset** (1908) applied a statistical tool called **'*t*-test**. The pen name of Mr. Gosset was 'Student' and hence this test is called as **Student's *'t'*-test**. Student's ***'t'*-test** is also known as ***t*-ratio** because it is a ratio of difference between two means. Later on **Aylmere Fisher** (1890–1962) developed student's '*t*'-test and explained it in various ways. In Student's '*t*' test we make a choise between two alternatives : (i) to accept the null hypotehsis (no difference between the two means) (ii) to reject the null hypotehsis i.e. the difference between the means of the two samples is statistically significant.

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Q. 23. ***Explain briefly about Yate's Correction.***

Ans. In statistics, **Yates' correction for continuity,** or **Yates' chi-square test** is used in certain situations when testing for independence in a **contingency table.**

It is a requirement that a chi-square test has the assumption that the discrete probability of observed frequencies can be approximated by the chi-squared distribution, which is continuous.

To overcome this, **Frank Yates,** an **English statistician**, suggested a correction for continuity which adjusts the formula for **Pearson's chi-square test** by subtracting 0.5 from the difference between each observed value and its expected value in a 2 × 2 contingency table. This reduces the chi-square value obtained and thus increases its ***p*-value.** It prevents overestimation of statistical significance for small data. This formula is chiefly used when at least one cell of the table has an expected frequency less than 5. Unfortunately, Yates' correction may tend to overcorrect. This can result in an overly conservative result that fails to reject the **null hypothesis** when it should. So it is suggested that Yates' correction is unnecessary even with quite low sample sizes, such as $\sum_{i} = 1\ O_i = 20$.

$$X^2_{\text{Yates}} = \sum_{i-1}^{N} \frac{(|O_i - E_i| - 0.5)^2}{E_i}$$

Where :

O_i = an observed requency

E_i = an expeted (theoretical) frequency, asserted by the null hypotehsis

N = jumber of distinct events

we can write $X^2_{\text{Yates}} = \dfrac{N(|ad - bc| - N/2)^2}{N_S N_F N_A N_B}$

In some case, this is better. $X^2_{\text{Yates}} = \dfrac{N(\max(0, |ad - bc| - N/2))^2}{N_S N_F N_A N_B}$

Q. 24. ***Explain briefly about Standard deviation.***

Ans. Standard Deviation may be defined as **"the square root of the arithmetic mean of the squares of deviations from the arithmetic mean".**

Karl Pearson 1893 gave the concept of Standard Deviation. It is widely used measures of studying dispersion.

Computation of Standard deviation *S* or (σ) for ungrouped data

Following six steps are observed before the computation of Standard deviation :

(i) Calculate the mean

(ii) Find the difference of observations from the mean

(iii) Add the squared values to get the sum of squares.

(iv) Divide this sum by the number of observations.

(v) Find the square root of this variance.

Apply following formula to calculate Standard Deviation.

$$S \text{ or } \sigma = \sqrt{\frac{\Sigma x^2}{N}} \text{ or } \sigma = \sqrt{\frac{\Sigma x^2}{N-1}}$$

Where S = Standard Deviation; x = deviation obtained from mean i.e., $X - \overline{X}$.

N = Total number of observations.

[**Note :** S is computed by using $N - 1$ in the denominator of above formula instead of N, if the size of sample i.e. total number of observations are less than 30. If the size of sample is more than 30 then first mentioned formula :

$$S = \sqrt{\frac{\Sigma x^2}{N}} \text{ is applied]}$$

Worked example : Haemoglobin percent *g*/100 ml of liver feb *Wallago attu* was recorded as 23, 22, 20, 14, 16, 17, 18, 19 and 21. Calculate the Standard Deviation.

Solution : As suggested above prepare a table of 4 columns. First column or values of variables i.e. X. 2nd column for observation– mean $(X - \overline{X})$. 3rd or deviation (x) and 4th for deviation square (x^2).

Calculate the Mean $\overline{X} = \dfrac{180}{9} = 20.$

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Q. 25. ***Explain briefly about Chi-square test.***

Ans. Chi-square test is a test of statistical test of significance. This is used with data in the form of frequencies (i.e., number of occurence). These data must be independent of each other; generally, this precludes taking more than one measurement from a single individuals. It is possible to convert measurements into freuency data, but information is then lost. The 22nd letter of Greek alphabet is I (chi), so the chi-square has the symbol of I^2.

Uses of Chi-Square Test :

I. λ^2 is used to determine if a certain distribution differs from some pre-determined theoretical distribution.

II. Used in testing hypothesis concerning the significance of the difference of the responses of two or more groups to a stimulus of one or another.

III. Used in goodness of fit. (Pearsonian - λ^2)

Formula for determining c^2 :

The chi-square (λ^2) statistics is calculated as follows :

$$\lambda^2 = \Sigma\frac{(O-E)^2}{E}, \text{ is the general formula, alternative formula is,}$$

$$\lambda^2 = \Sigma\frac{O^2}{E^2} - N, \text{ where}$$

O = observed frequency in a class
E = expected frequency in a class
Σ = summation over all classes
N = total no. of observations.

From these equations, the value of λ^2 will be zero, if $O = E$ in each classes, but due to chance error this never happens and the observed results are based on the same principle from which expected frequencies are calculated.

The values of λ^2 depend on number of classes or in other words on the number of degrees of freedom (*df*) and the critical level of probability (5% or 1%). We can find the expected value of λ^2 from the table. This expected value can be compared with the value calculated from the data. If the tabular value is lower the results are significant observed results are not in agreement with the expected results.

Q. 26. ***Explain about Mode.***

Ans. Mode : Mode is the value of that items which possesses the maximum frequency i.e. it is that items which is repeated the largest number of itmes. Mode is the point of the greatest frequency of occurrence. It is the most common value for example in a observation we find.

22, 24, 20, 23, 21, 19, 23, 22, 20, 22, 20, 22, 23, 25, 21, 21, 22, 24, 23, 22, 23, 21, 22, 21

Calculate Mode : Step one-arrange the data

19, 20, 20, 20, 21, 21, 21, 21, 21, 21, 22, 22, 22, 22, 22, 25, 22, 23, 23, 23, 23, 23, 24, 25, 25

Step two –

value	19, 20, 21, 22, 23, 24, 25
Frequency	1 3 5 7 5 2 1

Now 22 is repeated the maximum number of 7 times

So mode = 22

$$\text{Mode} = L + \left(\frac{\Delta_1}{\Delta_1 + \Delta_2}\right)C$$

L = lower class boundary
C = length of modal class.
D_1 = Difference between frequencies of modal class.
D_2 = Difference between frequencies of modal class.
Mean – Mode = 3(Mean – Median)

Q. 27. ***Discuss about error.***

Ans. Standard Error—When more than one sample is drawn from a population, the standard deviation for each mean will be found to differ slightly. In theory the mean of different samples drawn from the sample population must be the same or very close to each other, so that a single sample s a reliable true measure of the population. But in practice this is not so and means of samples show variations. A statistical constant which measures the dispresion of the sample means around the total population mean is called standard eroor (SE), and is obtained by dividing standard deviation (s or SD) by the sample size, N.

$$SE = \frac{SD}{\sqrt{(N)}}$$

Q. 28. ***Explain briefly about standard deviation.***

Ans. Standard deviation—It is the square root of the Quotient obtained by dividing the sum of the square of deviations of items from the arithmetic mean by the number observations.

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$$\therefore \text{ Standard deviation or } \sigma = \sqrt{\frac{\text{Sum of Squars of deviation A.M.}}{\text{number of observations}}}$$

Thus variance or mean square deviation is sqaure of standard deviation.

variance = σ^2

S.D. can be calculated as follows :

(a) For ungrouped data.

$$SD = \frac{\sqrt{\Sigma d^2}}{n}$$

Where 'd' is the deviation of value from mean.

Example : Find S.D. of 120, 60, 80, 21, 100, 40, 140

$$\text{Mean} = \frac{120+60+80+20+100+40+140}{5} = \frac{560}{7} = 80$$

Item	120	60	80	20	100	40	1
d	40	20	0	60	20	40	
d^2	1600	400	0	3600	400	1600	36

Note : $d = 120 - 80 = 40$; 60 80 = 20 and so on.

$\Sigma d^2 = 1600 + 400 + 0 + 3600 + 400 + 1600 + 3600 = 11200$

$$\sigma = \frac{\sqrt{Sd^2}}{n} = \frac{\sqrt{11200}}{7} = 40$$

Variace = $(SD)^2$

$= (40)^2 = 1600$

(b) For discrete Series

$$S = \frac{\sqrt{\Sigma fd^2}}{n}$$

$$\text{Or, } SD = \sqrt{\frac{\Sigma f D^2}{n} - \left(\frac{\Sigma f D}{n}\right)^2}$$

D, is the deviatio of value from provisional mean.

and f = frequency.

Q. 29. ***Explain the term Biometry giving its application to genetics, agriculture and other sciences.***

Ans. Biometry or Quantitative biology is the application of statistical methods to biological fact.s This science was stored by Sir Francis Galton (1822–1911) and was developed by Karl Pearson. (1857–1936) and his students. Through the researches of Fisher, Haldane and others, biometry had today become a very exact tool in the hand of geneticists.

Bio Statistics constitute an integral part of every biological, scientific and economic inquiry. It is indispensable in almost all the spheres of human activity and knowledge. If affects every body and touches life at many places.

In biological or agricultural sciences, we repeat the single experiment with several replicates and several times, but the two experiments do not provide the exactly identical answers. So the generalization is to be made. Making such a generalizations we need deductive logic and we make certain assumptions about the nature of our data, the method of data collected etc. to arrive at the conclusions.

The main objective of the statistical theory is the collection, classification and measured evaluation of the facts as a basis for inference.

The biostatistics is mainly concerned in the following three fold purposes—

1. To design or to plan experimental investigation (experiments) and sample surveys for generating statistical data.

2. To summarize the data in suitable tables, diagrams, charts and numbers.

3. To draw valid inferences from the data and forecast the future out comes in the face of uncertainty, subject to certain minimal assumptions.

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